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IN THE UNITED STATES PATENT & TRADEMARK OFFICE

IN RE APPLICATION OF	:
SHUSHI IKEDA, ET AL.	: EXAMINER: YEE, DEBORAH
SERIAL NO: 10/626,612	:
FILED: JULY 25, 2003	: GROUP ART UNIT: 1742
FOR: STEEL SHEET WITH EXCELLENT BENDABILITY	:

DECLARATION UNDER 37 C.F.R. § 1.132

COMMISSIONER FOR PATENTS
ALEXANDRIA, VIRGINIA 22313

SIR:

I, Shushi IKEDA, a citizen of Japan, hereby declare and state that:

1. I have a Ph.D. degree, which was conferred upon me in 1998 by Osaka University located in Osaka prefecture.

2. I have been employed by Kobe Steel Ltd. since 1990 and I have a total of 7 years of work and research experience in the field of high strength steel sheets.

3. The specification at Tables 1 and 2 discloses tensile strength (TS) and bendability (R_0 and R_1) data for steel sheet Samples 1-13. For the bendability data, "x" denotes the presence of cracking, and "o" denotes the absence of cracking). Tables 1 and 2 are reproduced below.

Table 1

Steel Sample	Chemical composition (mass%)						
	C	Si	Mn	P	S	Al	Others
A	0.033	1.48	1.50	0.03	0.006	0.032	-
B	0.096	1.54	1.54	0.03	0.004	0.034	-
C	0.157	1.57	1.53	0.02	0.004	0.033	-
D	0.204	1.55	1.45	0.04	0.005	0.035	-
E	0.151	0.48	1.55	0.04	0.005	1.030	-
F	0.147	0.30	0.32	0.04	0.004	0.030	-
G	0.150	1.46	1.55	0.03	0.005	0.033	Mo:0.2
H	0.147	1.52	1.48	0.04	0.005	0.032	Ni:0.2
I	0.154	1.44	1.50	0.03	0.006	0.028	Cu:0.2
J	0.151	1.53	1.54	0.03	0.004	0.032	Ca:0.001

Table 2

No.	Steel type	Retained austenite (area%)	Ferrite (area%)	Bainite (area%)	Pearlite (area%)	Martensite (area%)	Number of carbide grains per 2000 μm²	TS (MPa)	El (%)	R_0	R_1
1	A	0	96	0	0	4	6	460	33	O	O
2	B	9	84	5	0	2	12	594	34	O	O
3	C	13	79	6	0	2	22	673	33	O	O
4	D	16	77	6	0	1	25	855	31	O	O
5	E	11	86	3	0	0	18	649	29	O	O
6	F	0	83	5	12	0	--	545	22	×	×
7	G	12	82	5	0	1	20	982	24	O	O
8	H	13	80	6	0	1	13	872	29	O	O
9	I	12	83	4	0	1	9	902	27	O	O
10	J	13	80	5	0	2	17	650	32	O	O
11	D	3	70	3	24	0	--	785	21	×	×
12	D	17	76	5	0	2	56	878	29	×	×
13	D	13	83	4	0	0	65	860	33	×	O

4. The specification at page 12, lines 2-10, outlines the procedure used to prepare Sample Nos. 1-10. The specification at page 12, line 11 to page 13, line 5 outlines the procedure used to prepare Sample Nos. 11-13.

5. The following additional experiments were carried out by me or under my direct supervision and control.

6. Additional Samples A-I were prepared by different procedures as specified below.

Sample A:

This heat treatment consists of heating up to 850°C (above A_1 point and below A_3 point) and keeping this temperature for 120 seconds (for annealing), cooling to 700°C at an average rate of 5°C/s and keeping this temperature for 15 seconds, cooling to 400°C at an average rate of 15°C/s and keeping this temperature for 15 seconds (for austempering), and air cooling to room temperature at an average rate of 5°C/s.

Sample B:

This heat treatment consists of heating up to 850°C (above A_1 point and below A_3 point) and keeping this temperature for 120 seconds (for annealing), cooling to 700°C at an average rate of 5°C/s and keeping this temperature for 15 seconds, cooling to 420°C at an average rate of 15°C/s and keeping this temperature for 60 seconds (for austempering), and air cooling to room temperature at an average rate of 5°C/s.

Sample C:

This heat treatment consists of heating up to 850°C (above A_1 point and below A_3 point) and keeping this temperature for 120 seconds (for annealing), cooling to 700°C at an average rate of 5°C/s and keeping this temperature for 15 seconds, cooling to 420°C at an average rate of 15°C/s and keeping this temperature for 180 seconds (for austempering), and air cooling to room temperature at an average rate of 5°C/s.

Sample D:

This heat treatment consists of heating up to 850°C (above A_1 point and below A_3 point) and keeping this temperature for 120 seconds (for annealing), cooling to 700°C at an average rate of 5°C/s and keeping this temperature for 15 seconds, cooling to 420°C at an average rate of 15°C/s and keeping this temperature for 300 seconds (for austempering), and air cooling to room temperature at an average rate of 5°C/s.

Sample E:

This heat treatment consists of heating up to 850°C (above A_1 point and below A_3 point) and keeping this temperature for 120 seconds (for annealing), cooling to 700°C at an average rate of 5°C/s and keeping this temperature for 15 seconds, cooling to 420°C at an average rate of 15°C/s and keeping this temperature for 600 seconds (for austempering), and air cooling to room temperature at an average rate of 5°C/s.

Sample F:

This heat treatment consists of heating up to 850°C (above A_1 point and below A_3 point) and keeping this temperature for 120 seconds (for annealing), cooling to 700°C at an average rate of 5°C/s and keeping this temperature for 15 seconds, cooling to 420°C at an average rate of 15°C/s and keeping this temperature for 60 seconds (for austempering), and air cooling to room temperature at an average rate of 5°C/s.

Sample G:

This heat treatment consists of heating up to 850°C (above A_1 point and below A_3 point) and keeping this temperature for 120 seconds (for annealing), cooling to 700°C at an average rate of 5°C/s and keeping this temperature for 15 seconds, cooling to 420°C at an average rate of 15°C/s and keeping this temperature for 180 seconds (for austempering), and air cooling to room temperature at an average rate of 5°C/s.

Sample H:

This heat treatment consists of heating up to 850°C (above A_1 point and below A_3 point) and keeping this temperature for 120 seconds (for annealing), cooling to 700°C at an average rate of 5°C/s and keeping this temperature for 15 seconds, cooling to 420°C at an average rate of 15°C/s and keeping this temperature for 60 seconds (for austempering), and air cooling to room temperature at an average rate of 5°C/s.

Sample I:

This heat treatment consists of heating up to 850°C (above A_1 point and below A_3 point) and keeping this temperature for 120 seconds (for annealing), cooling to 700°C at an average rate of 5°C/s and keeping this temperature for 15 seconds, cooling to 420°C at an average rate of 15°C/s and keeping this temperature for 180 seconds (for austempering), and air cooling to room temperature at an average rate of 5°C/s.

7. The tables on the following page summarizes the tensile strength and bendability results obtained using three different steels (Types D, C, and H).

Sapmel No. of Table 2	Retained austenite (area%)	Ferrite (area%)	Bainite (area%)	Pearlite (area%)	Martensite (area%)	Number of carbide grains per 2000 μ m2	TS (MPa)	EL(%)	R0	R1
#4	16	77	6	0	1	25	855	31	○	○
#11	3	70	3	24	0	-	785	21	×	×
#12	17	76	5	0	2	56	878	29	×	×
#13	13	83	4	0	0	65	860	33	×	○

■ Additional Data (New Data)

Sapmel No.	Retained austenite (area%)	Ferrite (area%)	Bainite (area%)	Pearlite (area%)	Martensite (area%)	Number of carbide grains per 2000 μ m2	TS (MPa)	EL(%)	R0	R1	Composition
A	17	76	4	0	3	10	861	30	○	○	Steel Type D at Table 1
#4 (Table2)	16	77	6	0	1	25	855	31	○	○	
B	10	81	9	0	0	38	851	30	○	○	
C	7	83	10	0	0	45	812	27	×	○	
D	6	82	12	0	0	55	805	27	×	×	
E	4	83	13	0	0	67	798	26	×	×	

Sapmel No.	Retained austenite (area%)	Ferrite (area%)	Bainite (area%)	Pearlite (area%)	Martensite (area%)	Number of carbide grains per 2000 μ m2	TS (MPa)	EL(%)	R0	R1	Composition
#3 (Table 2)	13	79	6	0	2	22	673	33	○	○	Steel Type C at Table 1
F	12	75	9	0	4	47	665	30	×	○	
G	10	76	10	0	4	56	660	29	×	×	

Sapmel No.	Retained austenite (area%)	Ferrite (area%)	Bainite (area%)	Pearlite (area%)	Martensite (area%)	Number of carbide grains per 2000 μ m2	TS (MPa)	EL(%)	R0	R1	Composition
#8 (Table2)	13	80	6	0	1	13	872	29	○	○	Steel Type H at Table 1
H	11	82	7	0	0	34	871	30	○	○	
I	10	81	9	0	0	63	862	28	×	○	

8. For steel type D, Samples A, 4 and B contained a number of carbide grains that was less than 40 per 2000 μm^2 and exhibited a combination of high strength and excellent bendability. In contrast, Samples C, D and E contained a number of carbide grains that was greater than 40 per 2000 μm^2 and exhibited low strength and poor bendability. Samples 12 and 13 contained a number of carbide grains that was greater than 40 per 2000 μm^2 and exhibited high strength but poor bendability.

9 Samples 4, 11-13 and A-E are plotted on the following chart of tensile strength v. number of carbide grains per 2000 μm^2. The comparison of Samples A, 4 and B with C, D, E and 11-13 on the chart shows that a significant improvement in the combination of high strength and excellent bendability is achieved by the present invention by controlling the number of carbide grains to be less than 40 per 2000 μm^2.

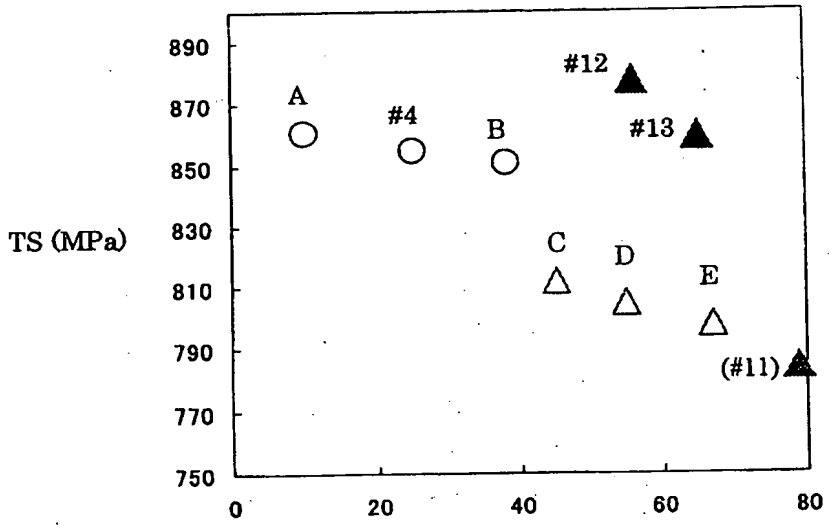

Figure : Relationship between Number of carbide grains and TS
(New Data of Steel Type D and Same Data of Table 2)

10. For steel type C, the tables above show that Sample 3 contained a number of carbide grains that was less than 40 per 2000 μm^2 and exhibited a combination of high strength and excellent bendability. In contrast, Samples F and G contained a number of carbide grains that was greater than 40 per 2000 μm^2 and exhibited lower strength and poor bendability.

11. For steel type H, the tables above show that Samples 8 and H contained a number of carbide grains that was less than 40 per 2000 μm^2 and exhibited a combination of high strength and excellent bendability. In contrast, Sample I contained a number of carbide grains that was greater than 40 per 2000 μm^2 and exhibited lower strength and poor bendability.

12. The data in the tables shows that a significant improvement in the combination of high strength and excellent bendability is achieved by the present invention over the critical range of "no more than 40 carbide grains per 2000 μm^2" in the steel sheet.

13. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of this application or any patent issuing thereon.

14. Further declarant saith not.

Date: _____ _____

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Shushi IKEDA